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09/463,643	05/01/2000	SHUJI NAKAMURA	NICHIA-00700	6608

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EXAMINER	
BAUMEISTER, BRADLEY W	
ART UNIT	PAPER NUMBER
2815	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 09/463,643	Applicant(s) Nakamura et al.
	Examiner B. William Baumeister	Art Unit 2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136 (a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1) ☒ Responsive to communication(s) filed on *Oct 4, 2002*.

2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.

3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11; 453 O.G. 213.

Disposition of Claims

4) ☒ Claim(s) *31-47* is/are pending in the application.

4a) Of the above, claim(s) _____ is/are withdrawn from consideration.

5) ☐ Claim(s) _____ is/are allowed.

6) ☒ Claim(s) *31-47* is/are rejected.

7) ☐ Claim(s) _____ is/are objected to.

8) ☐ Claims _____ are subject to restriction and/or election requirement.

Application Papers

9) ☐ The specification is objected to by the Examiner.

10) ☐ The drawing(s) filed on _____ is/are a) ☐ accepted or b) ☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.

If approved, corrected drawings are required in reply to this Office action.

12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

13) ☐ Acknowledgement is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a) ☐ All b) ☐ Some* c) ☐ None of:

1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

*See the attached detailed Office action for a list of the certified copies not received.

14) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. § 119(e).

a) ☐ The translation of the foreign language provisional application has been received.

15) ☐ Acknowledgement is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s). _____
4) ☐ Interview Summary (PTO-413) Paper No(s). _____
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other:

DETAILED ACTION

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless -
>
> (e) the invention was described in-
> (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effect under this subsection of a national application published under section 122(b) only if the international application designating the United States was published under Article 21(2)(a) of such treaty in the English language; or
> (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that a patent shall not be deemed filed in the United States for the purposes of this subsection based on the filing of an international application filed under the treaty defined in section 351(a).

2. Claims 31-37, 39-41, 43-45 are rejected under 35 U.S.C. 102(e) as being anticipated by Itaya et al. '017 (previously made of record). Itaya discloses various embodiments of nitride-based light emitters having a p-active-n structure, and optional features that may be employed in various embodiments.

a. Regarding claims 31, 33-36, 39, 40 and 43-45, note e.g., embodiment 2 depicted in Fig 8D as modified by undepicted embodiment 4 wherein an additional undoped GaN layer (constituting the first layer) is interposed between the low temperature 40 nm GaN buffer (LT-GaN) 502 and the 4 micron n-doped GaN layer 503 (col. 16, lines 33-). Either GaN layer 503, AlGaN layer 504 or alternatively the combination of both of layers 503 and 504 can be labeled as Applicant's second layer. Undoped, 0.1 micron GaN layer 505 constitutes the third layer. Claim

45 is anticipated under the interpretation that the combination of layers 503 and 504 constitutes Applicant's claimed second layer.

b. Regarding claims 35-37 and 45, note embodiment 9 depicted in FIG 16. The n-active-p laser diode includes the following three-layer laminated structure on a substrate 11: a first layer of 0.3-micron, undoped GaN 13; a second layer of 1.5 micron, 1e18-doped Si-AlGaN 14; and a third layer of 0.2 micron 5e17-doped Si-AlGaN. These layers are formed on a 30-nm LT-GaN buffer 12 that is interposed between the first layer and the substrate.

c. Regarding claims 31-35, 39, 41 and 43-45, note embodiment 5 as depicted in FIGs. 10 and 11 and embodiment 6 which modifies FIG 10 as depicted in Fig 12. Undoped LT-GaN layer 102 constitutes the first layer; either of 3-micron n-GaN layer 103 and/or 0.25 micron n-AlGaN layer 105 constitutes the second layer; 0.1-micron undoped (In)GaN optical guide 106a constitutes the third layer; and the MQB region of the plurality of layers jointly labeled as 106 reads on the active layer, as claimed. The optical guide may be composed of u-GaN (FIG 11) or alternatively InGaN (FIG 12).

3. Claims 31-37, 39, 41 and 43-45 are rejected under 35 U.S.C. 102(e) as being anticipated by or, in the alternative, under 35 U.S.C. 103(a) as obvious over Itaya et al. '017 (previously made of record) as applied to the claims above.

a. Regarding claims 32 and 37 and the above-stated rejection based on embodiment 2 depicted in Fig 8D as modified by embodiment 4 (see paragraph 2a), the disclosure in relation to

embodiment 4 does not set forth any particular thickness for the undoped GaN layer that is interposed between the 40-nm GaN buffer 502 and the 4-micron n-GaN second layer 503. As such, this portion of the disclosure does not expressly state that the first layer is "thin" as set forth in claim 32 (interpreted to mean that the first layer is thinner than the second, "thick" layer), nor that the first layer is thicker than the 40-nm buffer 502 as set forth in claim 37. Nonetheless, Itaya teaches in relation to embodiment 9, depicted in FIG 16, that a high temperature, undoped GaN (u-GaN) buffer layer 13 is interposed between a 30-nm low-temperature GaN buffer 12 and 1.5-micron n-AlGaN contact layer 14 for the purpose of improving crystallinity (e.g., cols. 21-22), the same purpose as the inclusion of the undepicted u-GaN layer in embodiment 4. Thus, one skilled in the art would have understood that the thickness of the u-GaN buffer layer of embodiment 4 would also have a thickness that is on this order of magnitude and therefore the claims are anticipated. Alternatively, assuming *arguendo* that the reference must be interpreted so narrowly as not sufficiently disclosing this fact so as to constitute a basis for an anticipation rejection, it nonetheless would have been obvious to one of ordinary skill in the art at the time of the invention to have formed the u-GaN layer of embodiment 4 to have a thickness that is on the same order of magnitude as that of the u-GaN layer 13 of embodiment 9 since they are both disposed in the same relative position and both perform the same function.

b. Regarding claims 36 and 37 and the above-rejection based on embodiment 5 depicted in Figs 10-12 (see paragraph 2c), the disclosure does not expressly state that an additional u-GaN layer (such as set forth in relation to embodiment 4 and 9) may be interposed

between the LT-GaN buffer 102 and the n-GaN contact 103. Nonetheless because the reference teaches that this feature may optionally be employed in various embodiments, one skilled in the art would have understood that the reference either implicitly teaches that this feature may also be employed in the embodiments of FIGs 10-12 (anticipation rejection), or alternatively, it would have at least been obvious to the skilled artisan to have so employed this layer in these embodiments for the reasons set forth above (obviousness rejection).

c. Regarding claims 31-37, 39, 41 and 43-45, note embodiment 10 as depicted in FIG 19 wherein an LD comprises a first layer of 0.3 micron HT-GaN formed on a 30-nm LT-GaN buffer. A 500-nm, (Al)GaN superlattice 24, either alone or alternatively in combination with n-AlGaN layer(s) 23 and/or 25 constitutes the second layer. Itaya discloses that this superlattice structure produces a 2DEG that lowers the contact resistance (col. 24, lines 41-52). The portion of the disclosure relating to embodiment 10 further sets forth a MQW active region 26, but unlike embodiment 5 of Fig 10, does not expressly set forth the presence of an n-side, undoped (In)GaN optical guide layer that would read on the third layer. Under an interpretation that the reference implies that an optical guide layer, as taught by embodiment 5, could also be employed in the tenth embodiment of Fig 19, the claims would be anticipated. This interpretation is supported by the fact that, just like the fifth embodiment, the tenth embodiment is also directed towards a laser diode, so the presence of an optical guide layer would be highly beneficial if not necessary to sufficiently confine light in the active region. Alternatively, under a more narrow interpretation that such a combination of embodiments is not at least implied, the inclusion of an u-(In)GaN

optical guide layer as taught by the fifth and sixth embodiments in the tenth embodiment would have been obvious at least for this stated reason.

4. Claims 31-39 and 41-47 are rejected under 35 U.S.C. 103(a) as being unpatentable over Itaya as applied to the claims immediately above in relation to the tenth embodiment of Fig 19, and further in view of Bruno '604 (previously made of record). Itaya teaches the employment of a doped (Al)GaN superlattice for injecting current to the active layer at low resistance by a pseudo two-dimensional electron gas (col. 24, lines 48-52). Itaya does not teach that the superlattice may include undoped wells.

a. Bruno teaches that (Al)GaN superlattices can be modulation-doped such that the dopant atoms are restricted to the barrier layers (col. 2, lines 59-60)--i.e., the GaN wells are undoped--for the purpose of reducing scattering and increasing mobility. It would have been obvious to one of ordinary skill in the art at the time of the invention to have provided a mod-doped superlattice for the superlattice 24 in the light emitter of Itaya for the purpose of reducing scattering and increasing mobility/reducing resistance as taught by Bruno.

b. As such, depending upon the specific claims, either the 30 nm u-LT-AlGaN layer 22 and/or the .3 micron u-HT-GaN reads on the first layer. And the mod-doped superlattice 24, either alone or in combination with the n-AlGaN layer(s) 23 and/or 25 reads on the second layer.

i. Further, under one interpretation, the (In)GaN optical guide layer 106a of the fifth and sixth embodiments reads on the third layer.

ii. Under an alternative interpretation, the uppermost well of the superlattice (a 50-angstrom u-GaN layer) reads on the third layer. As such, the n-AlGaN layer 25 reads on the limitation of claims 38 and 42 that requires the further presence of an n-clad, or an AlN-based layer, respectively, interposed between the 3rd layer and the active layer.

iii. Claim 42 further requires that the third layer, on which the AlN-based layer is formed, be composed of InGaN, and as such, the uppermost u-GaN well of Itaya/Bruno does not read on this limitation when interpreted as constituting the third layer. Nonetheless, it was well known to those of ordinary skill in the art at the time of the invention that InGaN has a smaller bandgap than GaN, and it was known by those skilled in the art how to form a (Al)GaN-barrier/InGaN-well superlattice. It would have been obvious to one of ordinary skill in the art at the time of the invention to have composed the mod-doped superlattice 24 of Itaya/Bruno with u-InGaN instead of u-GaN for the purpose of further improving upon the pseudo two-dimensional electron gas effects of the superlattice: reducing the well's effective bandgap to increase the carrier mobility/decrease the carrier resistance and thereby further increase the current injection into the active layer as desired by Itaya.

INFORMATION ON HOW TO CONTACT THE USPTO

5. Any inquiry concerning this communication or earlier communications from the examiner should be directed to the examiner, **B. William Baumeister,** at **(703) 306-9165.** The examiner can normally be reached Monday through Friday, 8:30 a.m. to 5:00 p.m. If the Examiner is not available, the Examiner's supervisor, Mr. Eddie Lee, can be reached at (703) 308-1690. Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the Group receptionist whose telephone number is (703) 308-0956.

B. William Baumeister

Patent Examiner, Art Unit 2815

December 11, 2002